

FIG. 1

(57) An integrated circuit device and method of making include an interconnect structure (22) and a capacitor (24). The interconnect structure (22) includes a metal line (27) and a contact (26), and the capacitor (24) includes upper and lower metal electrodes (44, 49). The method includes forming a dielectric layer (38, 40, 42) adjacent a semiconductor substrate, and simultaneously forming a first opening (57) for the interconnect structure and a second opening (56) for the capacitor, in the first dielectric layer. The method further includes selectively depositing a first conductive layer (54) to fill the first opening (57).

(54) Integrated circuit device having dual damascene interconnect structure and metal electrode capacitor and associated method for making

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(22) Date of filing: 06.01.2000

(21) Application number: 00300072.6

(43) Date of publication: 19.07.2000 Bulletin 2000/29

(51) Int. Cl. 7: H01L 21/768, H01L 27/108, H01L 21/02

EUROPEAN PATENT APPLICATION

EP 1 020 905 A1



Europäisches Patentamt  
European Patent Office  
Office européen des brevets



(19)

(12)

US 6,346,474

(11)

## Related Application

[0001] This application is based upon prior filed

copending provisional application Serial No. 60/115,703

filed January 12, 1999.

## Field Of The Invention

[0002] The present invention relates to the field of

integrated circuits, and, more particularly, to integrated

## Background Of The Invention

[0003] Capacitors are used in semiconductor

devices such as integrated circuits (ICs) for storing elec-

trical charge. In ICs such as dynamic random access

memory (DRAM), capacitors are used for storage in the

memory cells. Typically, capacitors formed in ICs

include a lower electrode made of, e.g., polycrystalline

silicon (polysilicon), a dielectric layer made of, e.g., tan-

talium pentoxide and/or barium strontium titanate, and

an upper electrode made of, e.g., titanium nitride, tita-

niun, tungsten, platinum or polysilicon.

[0004] In recent years, the development of the sem-

iconductor memory device has required higher packing

density, the area occupied by a capacitor of a DRAM

storage cell shrinks, thus decreasing the capacitance of

the capacitor because of its smaller electrode surface

area. However, a relatively large capacitance is required

to achieve a high signal-to-noise ratio in reading the

memory cell. Therefore, it is desirable to reduce the cell

dimension and yet obtain a high capacitance. This can

be accomplished with a metal electrode capacitor, for

example, which also may include a high-k dielectric.

[0005] Traditionally, interconnection between two

conductors in a semiconductor device has been pro-

vided by a plug structure such as a tungsten plug, for

example, for an electrical connection between first and

second metal lines. Such structures require three sepa-

rate processing steps including one for the formation of

each of the two conductors and one for the formation of

the tungsten plug structure. Additionally, greater interest

has been shown by manufacturers of semiconductor

devices in the use of copper and copper alloys for met-

allization patterns, such as in conductive vias and inter-

connects. Copper, compared to aluminum, has both

good electromigration resistance and a relatively low

electrical resistivity of about 1.7 ohm cm. Unfortunately,

copper is difficult to etch. Consequently, dual

damascene processes have been developed to simplify

the process steps and eliminate a metal etch step to

form copper interconnects. Dual damascene processes

are also used with aluminum interconnects.

[0006] A dual damascene structure has a bottom

portion or via that contacts an underlying conductor and

## Summary Of The Invention

damascene process.

electrode capacitor which is compatible with the dual

[0009] As can be seen from the above discussion,

there is a need for integration of a high-density metal

damascene process is undesirable.

etching; therefore, using a metal etch step within a dual

damascene process is used specifically to avoid metal

process. In other words, as discussed above, the dual

required is not fully compatible with the dual damascene

insulator-metal (MIM) capacitor, the metal etch step

forming a capacitor with metal electrodes, i.e., a metal-

the conductive layers as well as the CMP step. Also, if

capacitors requires additional time due to the etching of

[0008] Thus, the conventional process of making

subsequent layers are formed.

cal polishing (CMP) to planarize the oxide layer before

above the capacitors. This requires chemical mechani-

over the capacitors and results in surface topographies

titanium nitride, for example. Next an oxide is formed

conductive layers are typically formed of poly-silicon or

terming and etching the layered structure. The

between, forming a second conductive layer, and then pat-

first conductive layer, forming the dielectric therebe-

are usually formed in a separate level by depositing a

[0007] In the dual damascene process, capacitors

overlying conductive layer in separate processing steps.

This eliminates the need to form a plug structure and an

ously with the same conductive material, e.g., copper,

contact with each other, they can be filled simultane-

and top portions of a dual damascene structure are in

formation of a second conductor. Because the bottom

also has a top portion or inlaid trench that is used for the

interconnect structure. The dual damascene structure

replaces the function of a plug structure in a traditional

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### Brief Description Of The Drawings

dielectric layer portion. Thus, the metal line of the interconnect structure is preferably in the upper dielectric layer portion and the etch stop layer of the dielectric layer, and the contact of the interconnect structure is preferably in the lower dielectric layer portion of the dielectric layer. Also, the capacitor is preferably in the upper dielectric layer portion, the etch stop layer, and the lower dielectric layer portion of the dielectric layer.

[0018]

FIG. 1 is a cross-sectional view of an integrated circuit device including an interconnect structure and metal electrode capacitor in accordance with the present invention.

FIGS. 2-8 are cross-sectional views of an integrated circuit device to illustrate a dual damascene process for forming an interconnect structure and metal electrode capacitor in accordance with the present invention.

FIG. 9 is a lateral cross-sectional view through an upper portion of another embodiment of an integrated circuit device in accordance with the present invention.

### Detailed Description Of The Preferred Embodiments

[0019] The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. Like numbers refer to like elements throughout. The dimensions of layers and regions may be exaggerated in the figures for clarity.

[0020] Referring to FIG. 1, an integrated circuit device 20 including an interconnect structure 22 and metal electrode capacitor 24 formed on a semiconductor substrate 30 in accordance with the present invention, will now be described. The semiconductor substrate 30 is preferably silicon, or may be silicon or polysilicon layer or structure formed on the substrate. A plurality of devices, such as transistors (not shown), are formed in the substrate 30 using well known techniques. The integrated circuit device 20 includes a first dielectric layer 32 adjacent the substrate 30. The first dielectric layer is formed from any suitable dielectric, e.g., silicon dioxide, silicon nitride and/or any material or alloy of material having a desired dielectric constant. Other suitable materials include tantalum pentoxide and barium strontium titanate, for example, as long as the dielectric

first opening to form the interconnect structure, and forming the upper and lower metal electrodes with a capacitor dielectric therebetween to form the capacitor in the second opening. The first conductive layer may be formed by electroplating copper while masking the second opening, and may also include a barrier metal layer to at least line the first opening. The barrier metal layer preferably comprises tantalum nitride

[0013] Also, the step of simultaneously forming the

first opening and the second opening may comprise: simultaneously forming an upper portion of the first opening and an upper portion of the second opening;

and simultaneously forming a lower portion of the first opening and a lower portion of the second opening. Additionally, the upper portion of the first opening may have a greater width than the lower portion of the first opening, and the upper portion of the second opening may have substantially a same width as the lower portion of the second opening.

[0014] The dielectric layer may be formed of a lower

dielectric layer portion, an etch stop layer and an upper dielectric layer portion. Thus, the upper portion of the first opening and the upper portion of the second opening may be formed simultaneously in the upper dielectric layer portion and the etch stop layer. Also, the lower portion of the first opening and the lower portion of the second opening may be formed simultaneously in the lower dielectric layer portion.

[0015] The capacitor may be formed by depositing a lower metal layer to at least line the second opening

and to form the lower metal electrode, forming the capacitor dielectric layer on the lower metal layer, depositing an upper metal layer on the capacitor dielectric layer to form the upper metal electrode. Also, a second conductive layer may be selectively deposited to fill a remaining portion of the second opening. This second conductive layer preferably comprises copper, and the upper and lower metal electrodes of the capacitor preferably comprise tantalum nitride. The capacitor dielectric may be a high-k dielectric having, e.g., a dielectric constant greater than about 25.

[0016] The advantages in accordance with the present invention are also provided by an integrated circuit device including a dielectric layer adjacent a semiconductor substrate having first and second openings therein, an interconnect structure in the first opening and comprising a metal line and a metal contact depending therefrom, and a capacitor in the second opening and comprising upper and lower metal electrodes with a capacitor dielectric layer therebetween.

The capacitor may have a substantially planar upper surface substantially flush with adjacent upper surface portions of the dielectric layer. Also, the edges of the lower electrode and the capacitor dielectric layer may terminate at the upper surface of the capacitor.

[0017] Again, with respect to the method as set forth above, the dielectric layer may comprise a lower dielectric layer portion, an etch stop layer, and an upper

desired capacitor characteristics. The upper electrode com-

deposited by conventional techniques. This non-con-

deposited on the associated dielectric layer, e.g. the second dielectric layer 38, using CVD at temperatures between about 600 °C and 900 °C.

[0031] As shown in FIG. 3, a first set of openings 56 and 57 are selectively formed through the third dielectric layer 42 and also through the etch stop layer 40. Although the present description proceeds with the etching of the third dielectric layer 42 followed by the etching of the etch stop layer 40, other etching steps for etching the third dielectric layer and the etch stop layer can be used as would readily be appreciated by those skilled in the art. The openings, e.g., trenches 56 and 57, will later be used to form a metallization conductor or a capacitor as will be explained below.

[0032] As is known in the damascene process as shown in FIG. 4, at least a second set of selected openings 60 and 61 are etched in the second dielectric layer 38 within the bounds defined by each of the first set of openings 56 and 57. A photo resist shown by the dashed lines at 58 is applied to form the second set of openings 60 and 61. The photo resist is then removed by techniques known to those skilled in the art. As illustrated, the opening 62 is for forming a via between different layers, as is well known to those skilled in the art. However, although the opening 60 has been illustrated, as an example, as being substantially the same width as the above opening 56 in the third dielectric layer 42, this opening 60 may also be more narrow than the above opening 56 as is the case with openings 61 and 57.

[0033] As shown in FIG. 5, a photo resist 62 is formed over the openings 56 and 60. A barrier metal layer 52 is preferably formed to line openings 56, 57, 60 and 61 before the photo resist 62 is formed. A conductive metal layer 54, e.g. aluminum and/or copper, is selectively deposited over the third dielectric layer 42, such that the conductive metal layer 54 is deposited within the openings 57 and 61 and over at least portions of the third dielectric layer 42 adjacent the opening 57. The conductive metal layer 54 can be deposited by electroplating or chemical vapor deposition techniques well known to those skilled in the art. Of course if copper is used as the conductive metal layer 54, a copper seed layer (not shown) may be formed on the barrier metal layer 52. The photo resist 62 is then removed and the openings 56 and 60 are cleaned by techniques known to those skilled in the art. Referring to FIG. 6, a barrier metal layer 53, such as tantalum nitride, titanium nitride or tungsten nitride, is then deposited to complete the lower electrode 44. Next, the capacitor dielectric 46 is formed by deposition or epitaxial growth. The capacitor dielectric 46 is formed of a suitable dielectric material, e.g. silicon oxide, silicon nitride or tantalum oxide, having a desired dielectric constant. Preferably, the capacitor dielectric 46 has a dielectric constant greater than about 25 to achieve the desired capacitor characteristics. Then, a barrier metal layer 48 such as tantalum

nitride, titanium nitride or tungsten nitride, for example, is then deposited to form part of the upper electrode 49. As illustrated, the materials forming the electrodes 44 and 49 as well as the dielectric 46, have been blanket deposited over the upper surface of the integrated circuit device 20.

[0035] Referring to FIG. 7, a conductive metal layer 50, e.g. aluminum and/or copper, is deposited to form part the upper electrode 49, such that the conductive metal layer 50 is deposited within a remaining portion of the openings 56 and 60. This deposition step may involve selective deposition including a photo resist 64 formed over the interconnect structure 22, as illustrated. However, the conductive metal layer 50 may also be blanket deposited over the entire upper surface of the integrated circuit device 20. The conductive metal layer 50 can be deposited by electroplating or chemical vapor deposition techniques well known to those skilled in the art. Of course if copper is used as the conductive metal layer 50, a copper seed layer (not shown) may be formed on the upper electrode 48.

[0036] An upper surface of the integrated circuit device is then planarized using CMP, for example, as shown in FIG. 8. Thus the capacitor 24 has a substantially planar upper surface substantially flush with adjacent upper surface portions of the third dielectric layer 42. Also, edges of the lower metal 44 electrode and the capacitor dielectric 46 terminate at the upper surface of the capacitor 24. Accordingly, a dual damascene process is provided for making the integrated circuit device 20 of the present invention with a high-density capacitor 24 having metal electrodes 44, 49, and which is compatible and integrated with dual damascene structures such as the interconnect structure 22. The process of the present invention does not require etching metal layers or CMP of oxides to form a capacitor having metal electrodes.

[0037] Additionally, referring to FIG. 9 another embodiment the integrated circuit device 20 of the present invention is described. Because the lower electrode 44 surrounds the capacitor 24, a contact 66 may be formed in a side trench 68 to connect the capacitor 24 to an associated metal line such as the conductive layer 54. In this embodiment, an interconnect 34 (FIG. 1) would not be necessary to contact the lower electrode 44. This may also eliminate a layer and allow reduction of the dimensions of the integrated circuit 20. Furthermore, the trench 68 may be formed during the dielectric etch which forms the openings 56 and 57. This would also reduce the number of steps required in making the integrated circuit device 20.

[0038] The thicknesses of the various layers may vary as would be appreciated by those skilled in the art. For example, the first dielectric layer 32 can be deposited over the substrate by chemical vapor deposition (CVD) from a TEOS source gas and could have a thickness of about 400 to 600 nanometers or greater. The second and third dielectric layers 38 and 42 can also be

formed in a similar thickness range. The appropriate silicon nitride etch stop layer 40 can have a thickness between about 200 to 1,500 angstroms, for example. Naturally, this is only a range of thickness, which can vary depending on the thickness desired and the end use of the semiconductor devices.

[0039] Many modifications and other embodiments of the invention will come to the mind of one skilled in the art having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is understood that the invention is not to be limited to the specific embodiments disclosed, and that modifications and embodiments are intended to be included within the scope of the appended claims.

## Claims

1. A method of making an integrated circuit device including an interconnect structure and a capacitor, the interconnect structure comprising a metal line and a contact, and the capacitor comprising upper and lower metal electrodes, the method comprising the steps of:
  - forming a dielectric layer adjacent a semiconductor substrate;
  - simultaneously forming a first opening for the interconnect structure and a second opening for the capacitor, in the dielectric layer;
  - selectively depositing a first conductive layer to fill the first opening to form the interconnect structure; and
  - forming the upper and lower metal electrodes with a capacitor dielectric therebetween to form the capacitor in the second opening.
2. A method of making an integrated circuit device including an interconnect structure and a capacitor, the interconnect structure comprising a metal line and a metal contact, and the capacitor comprising upper and lower metal electrodes, the method comprising the steps of:
  - forming a dielectric layer adjacent a semiconductor substrate;
  - simultaneously forming a first opening for the interconnect structure and a second opening for the capacitor, in the dielectric layer;
  - selectively depositing a first metal conductive layer to fill the first opening;
  - removing the mask from the second opening; depositing a lower metal layer to at least line the second opening and to form the lower metal electrode of the capacitor;
  - forming a capacitor dielectric layer on the lower metal layer to form the capacitor dielectric of the capacitor;
  - forming a dielectric layer adjacent a semiconductor substrate;
  - simultaneously forming a first opening for the interconnect structure and a second opening for the capacitor, in the dielectric layer;
  - forming a mask over the second opening; selectively depositing a first metal conductive layer to fill the first opening;
  - removing the mask from the second opening; depositing a lower metal layer to at least line the second opening and to form the lower metal electrode of the capacitor;
  - forming a capacitor dielectric layer on the lower metal layer to form the capacitor dielectric of the capacitor;
3. An integrated circuit device comprising:
  - a semiconductor substrate;
  - a dielectric layer adjacent the semiconductor substrate having first and second openings therein;
  - an interconnect structure in the first opening and comprising a metal line and a metal contact depending therefrom; and
  - a capacitor in the second opening and comprising upper and lower metal electrodes with a capacitor dielectric layer therebetween.
4. A method according to claim 1 or 2, wherein the step of simultaneously forming the first opening and the second opening comprises:
  - simultaneously forming an upper portion of the first opening and an upper portion of the second opening; and
  - first opening and a lower portion of the second opening.
5. A method according to claim 4, wherein the upper portion of the first opening has a greater width than the lower portion of the first opening, and the upper portion of the second opening has substantially a same width as the lower portion of the second opening.
6. A method according to claim 1 or 2, wherein the step of forming the dielectric layer comprises:
  - forming a lower dielectric layer portion adjacent the semiconductor substrate;
  - forming an etch stop layer on the lower dielectric layer portion; and
  - forming an upper dielectric layer portion on the etch stop layer.
7. A method according to claim 6, wherein the step of simultaneously forming the first opening and the second opening comprises:
  - simultaneously forming an upper portion of the first opening and an upper portion of the second opening in the upper dielectric layer portion;
  - simultaneously forming an upper portion of the first opening and an upper portion of the second opening in the upper dielectric layer portion;

capacitor dielectric layer terminate at the upper surface of the capacitor, and/or wherein the metal line has a greater width than the metal contact; and wherein the second opening has a substantially uniform width, and/or wherein the dielectric layer comprises:

a lower dielectric layer portion adjacent the semiconductor substrate; an etch stop layer on the lower dielectric layer portion; and an upper dielectric layer portion on the etch stop layer.

14. An integrated circuit device according to claim 13, wherein the metal line is in the upper dielectric layer portion and the etch stop layer, and the contact is in the lower dielectric layer portion; and wherein the capacitor is in each of the upper dielectric layer portion, the etch stop layer, and the lower dielectric layer portion.

15. An integrated circuit device according to claim 14, wherein the metal line has a greater width than the dielectric layer, having the capacitor therein, has a substantially uniform width, and/or wherein the interconnect structure comprises copper, and/or wherein the interconnect structure comprise a copper layer and a barrier metal layer adjacent thereto; and/or wherein the barrier metal layer comprises tantalum nitride; and/or wherein each of the upper metal electrodes of the capacitor comprises tantalum nitride; and/or wherein the upper metal electrode of the capacitor comprises tantalum nitride and copper; and wherein the lower metal electrode comprises tantalum nitride, and/or wherein the capacitor comprises tantalum nitride, and/or wherein the capacitor dielectric has a dielectric constant greater than about 25.

16. An integrated circuit device according to claim 3, further comprising a capacitor contact in the dielectric layer and electrically connecting the metal line of the interconnect structure and the lower metal electrode of the capacitor.

12. A method according to claim 1 or 2 further comprising the step of forming a capacitor contact in the dielectric layer and electrically connecting the metal line of the interconnect structure and the lower metal electrode of the capacitor.

13. An integrated circuit device according to claim 3, wherein the capacitor has a substantially planar upper surface substantially co-planar with adjacent upper surface portions of the dielectric layer, and/or wherein edges of the lower electrode and the

tion and the etch stop layer; and simultaneously forming a lower portion of the first opening and a lower portion of the second opening in the lower dielectric layer portion; the upper portion of the first opening having a greater width than the lower portion of the first opening, and the upper portion of the second opening having a substantially same width as the lower portion of the second opening.

8. A method according to claim 1, wherein the step of selectively depositing the conductive layer in the first opening comprises electro-depositing copper while optionally masking the second opening, and/or wherein the step of selectively depositing the conductive layer in the first opening comprises:

depositing a barrier metal layer to at least line the first opening; and electro-depositing copper to fill the lined first opening.

9. A method according to claim 1, 2 or 8, wherein the barrier metal layer comprises tantalum nitride.

10. A method according to claim 1 or 2, wherein the step of forming the capacitor in the second opening comprises:

depositing a lower metal layer to at least line the second opening and to form the lower metal electrode; forming the capacitor dielectric layer on the lower metal layer; depositing an upper metal layer on the capacitor dielectric layer to form the upper metal electrode; depositing a second conductive layer to fill a remaining portion of the second opening.

11. A method according to claim 10, wherein the second conductive layer comprises copper, and/or wherein the upper and lower metal electrodes of the capacitor comprise tantalum nitride, and/or wherein the capacitor dielectric has a dielectric constant greater than about 25.

12. A method according to claim 1 or 2 further comprising the step of forming a capacitor contact in the dielectric layer and electrically connecting the metal line of the interconnect structure and the lower metal electrode of the capacitor.

13. An integrated circuit device according to claim 3, wherein the capacitor has a substantially planar upper surface substantially co-planar with adjacent upper surface portions of the dielectric layer, and/or wherein edges of the lower electrode and the

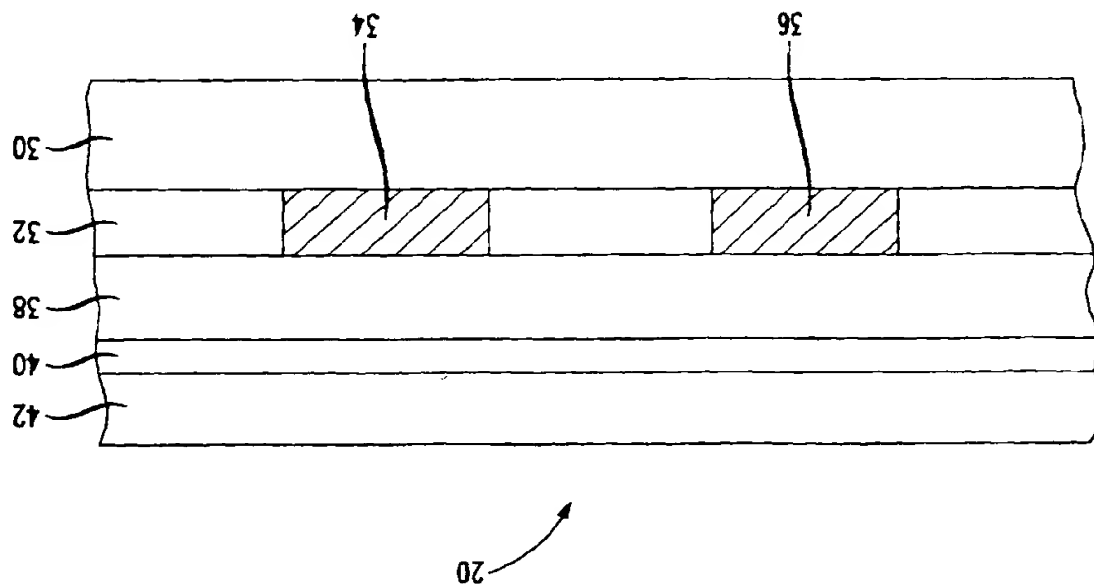


FIG. 2

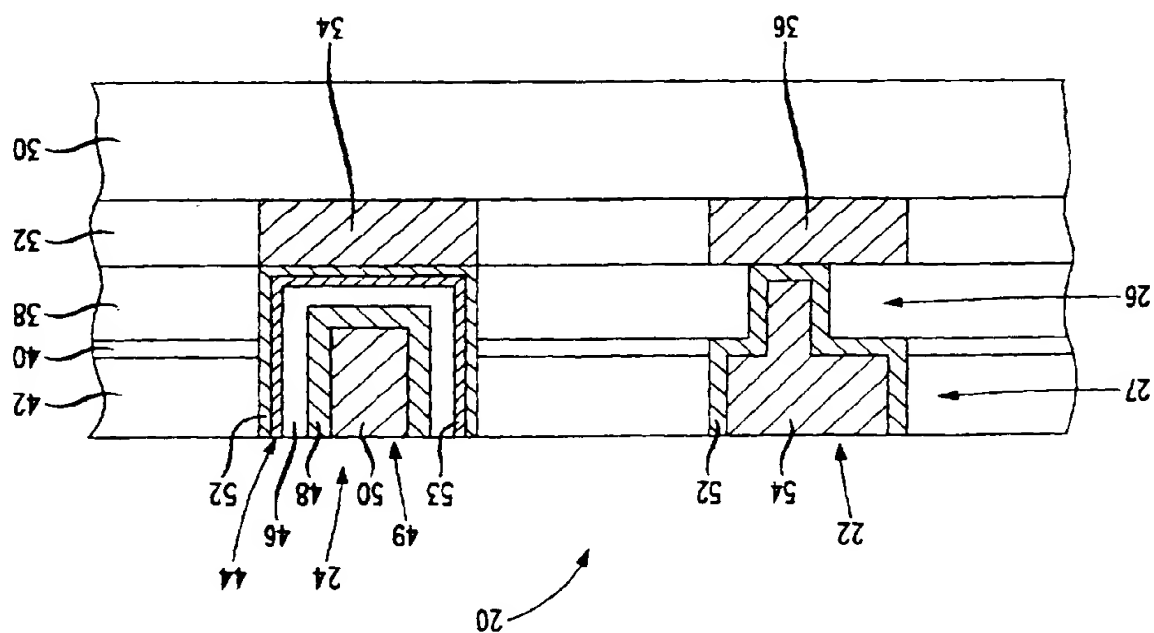


FIG. 1



FIG. 3

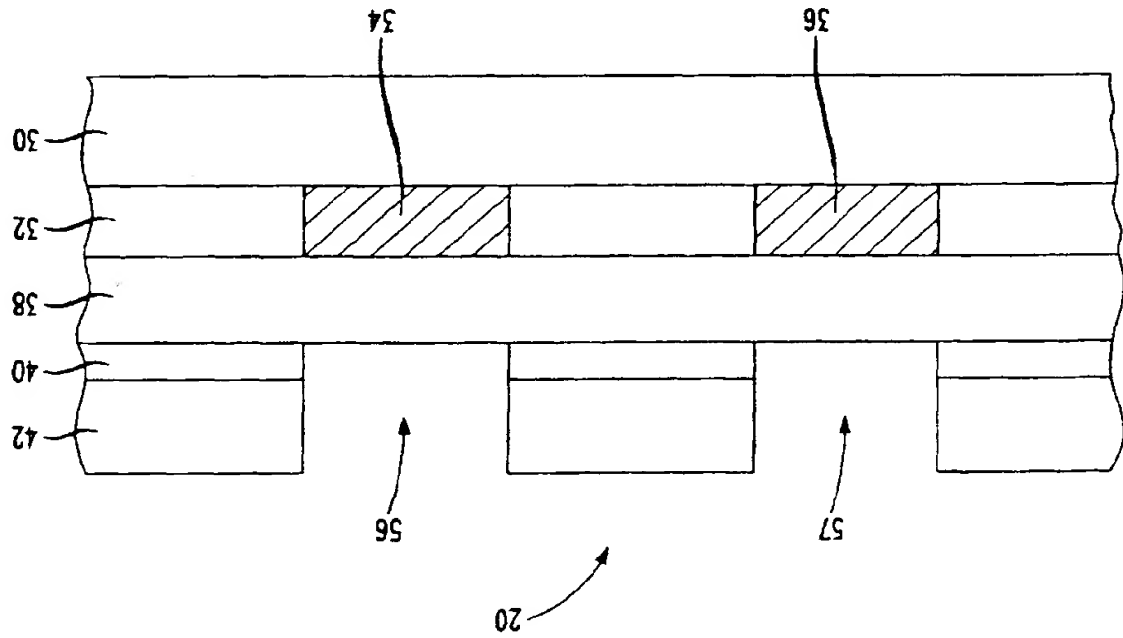


FIG. 4

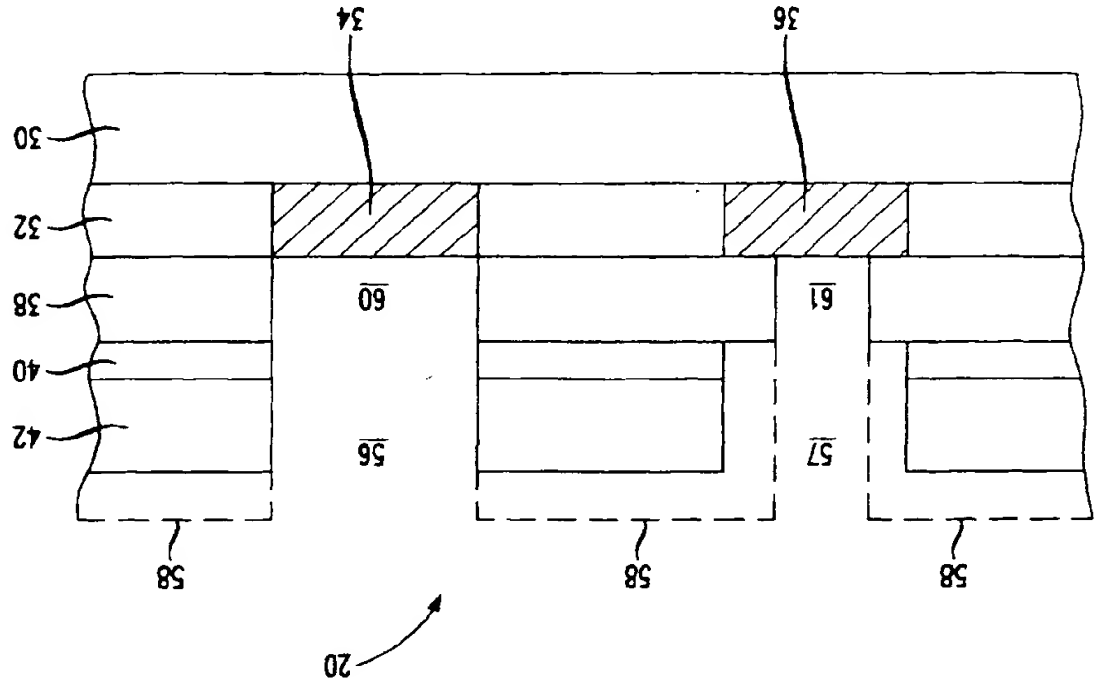


FIG. 5

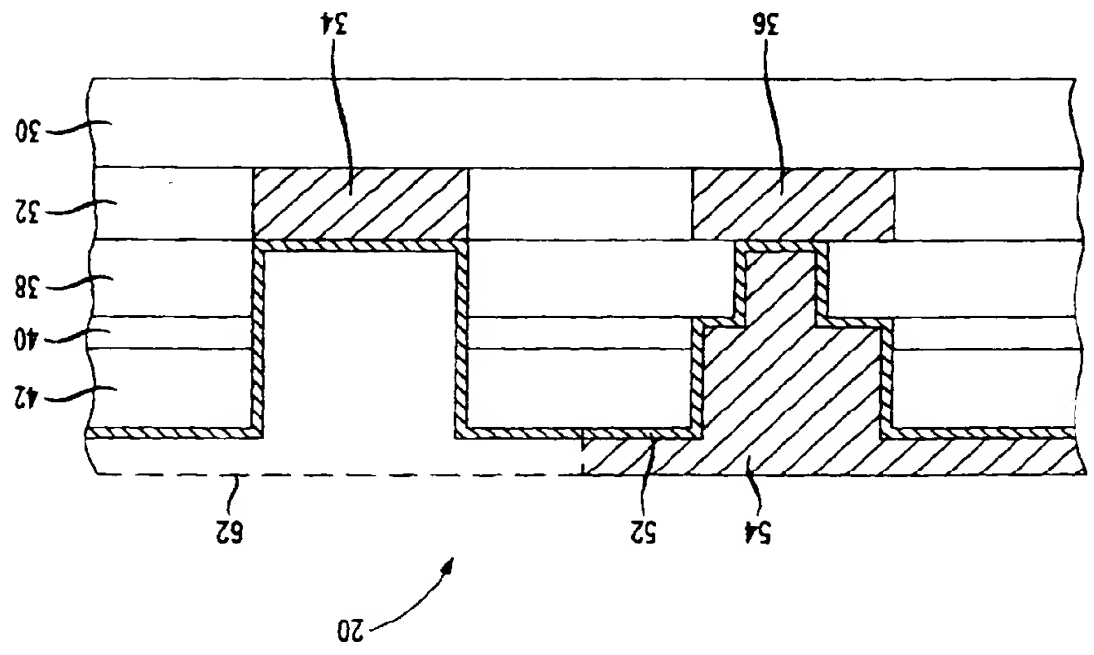


FIG. 6

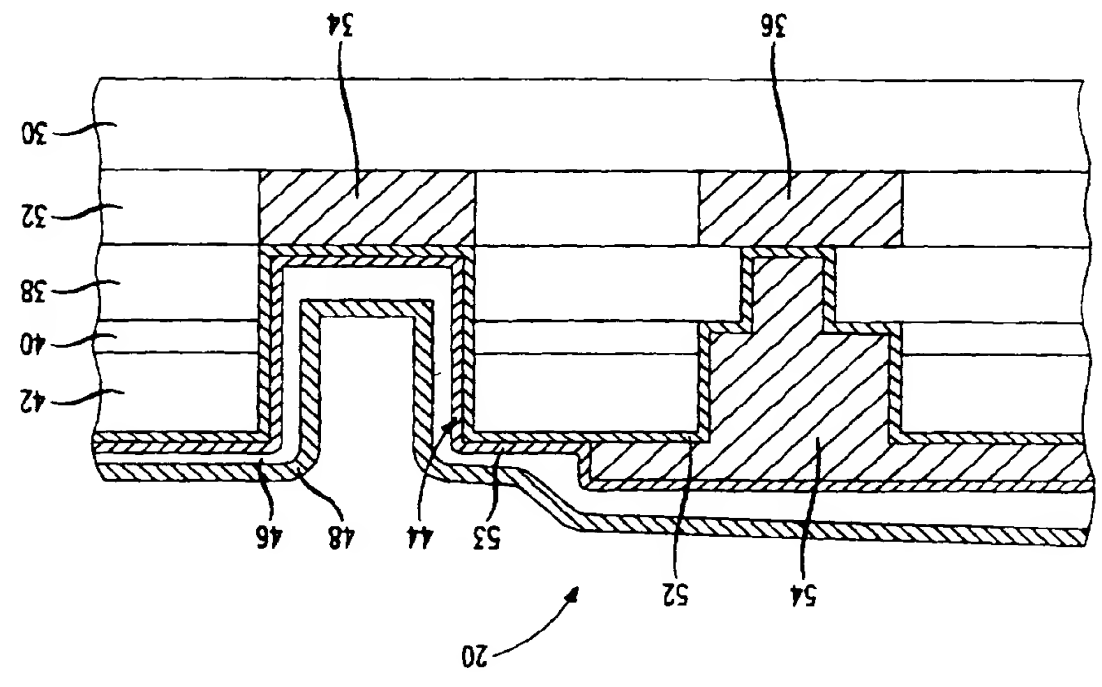


FIG. 7

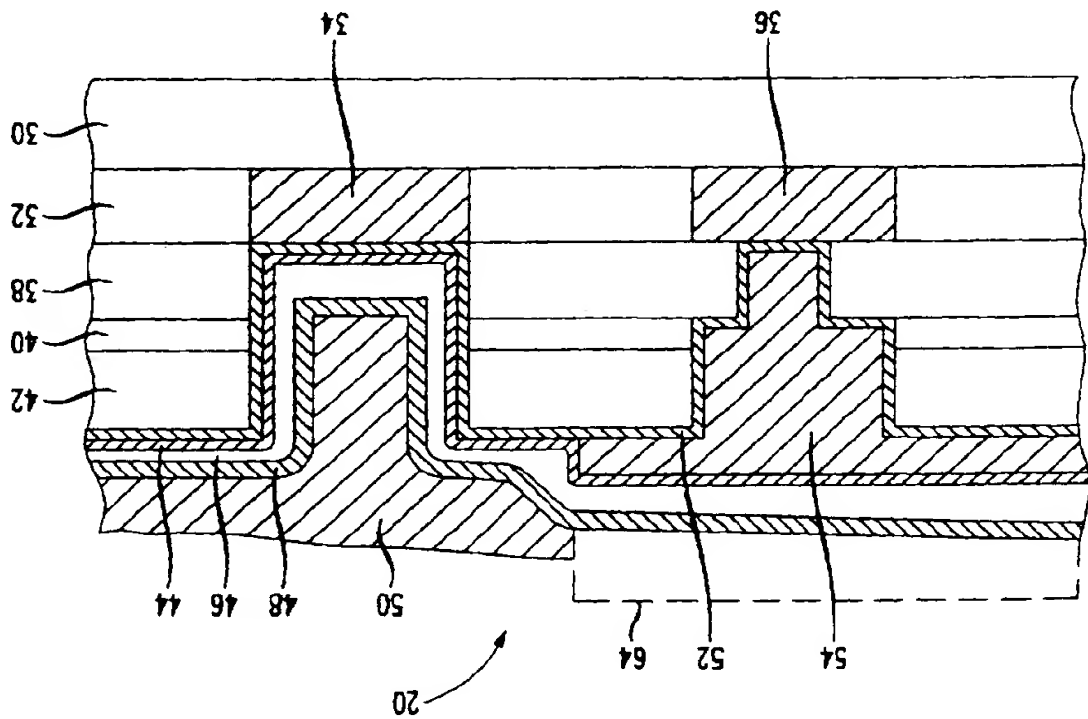
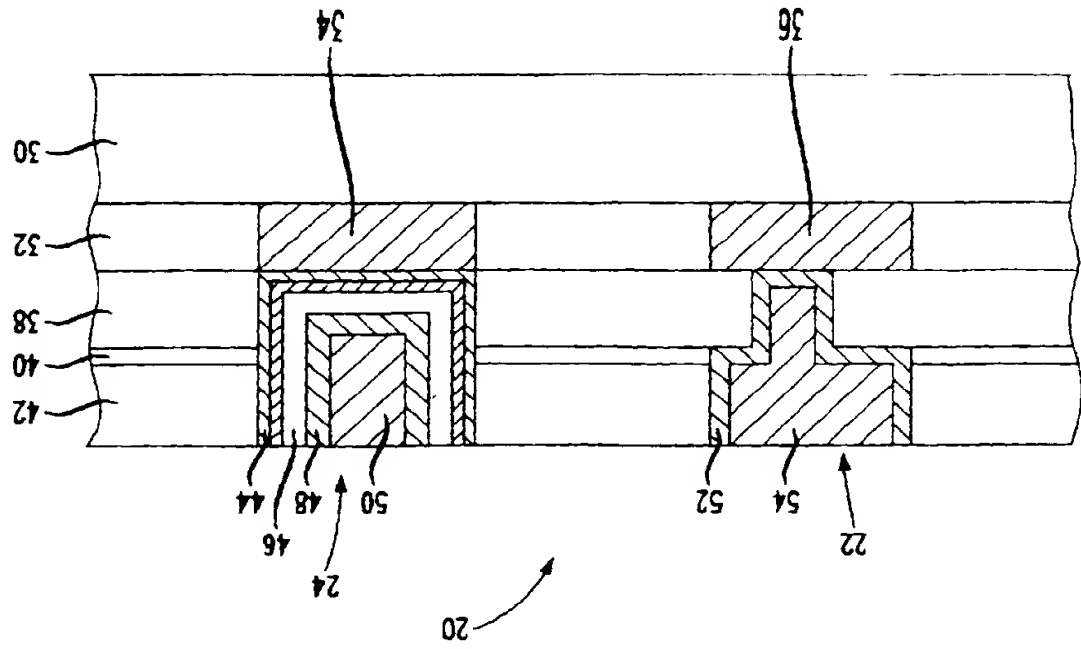


FIG. 8



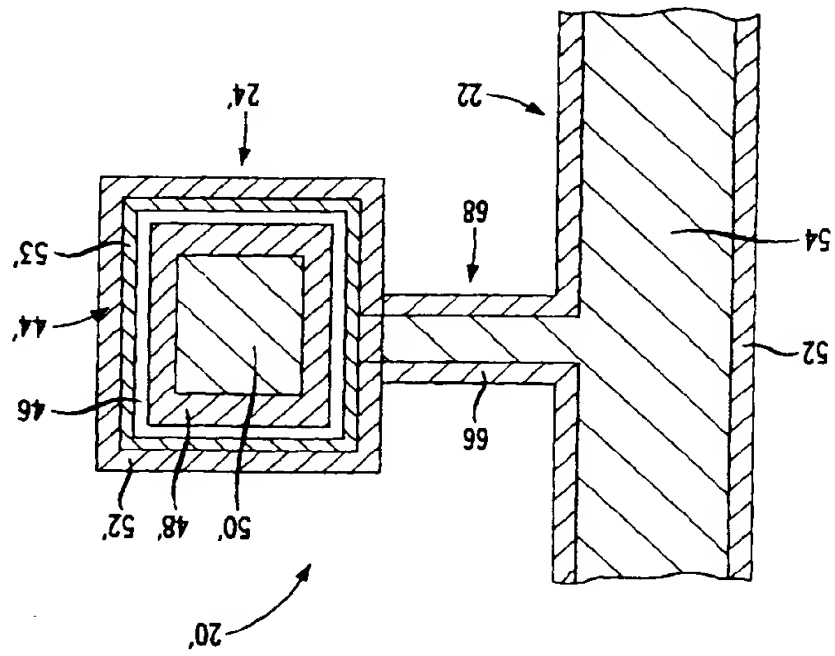


FIG. 9



**DOCUMENTS CONSIDERED TO BE RELEVANT**

DOCUMENTS CONSIDERED TO BE RELEVANT		CLASSIFICATION OF THE APPLICATION (INCL.7)	
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	Relevant to claim
X	PATENT ABSTRACTS OF JAPAN VOL. 013, no. 173 (E-748), 24 April 1989 (1989-04-24) -8 JP 01 004056 A (HITACHI LTD.), 9 January 1989 (1989-01-09) * abstract; figures 1-6 *	3	H01L21/768 H01L27/108 H01L21/02
A	* abstract; figures 1-6 *	1,2,4,10	
X	PATENT ABSTRACTS OF JAPAN VOL. 017, no. 702 (E-1482), 21 December 1993 (1993-12-21) -8 JP 05 243517 A (NEC CORP.), 21 September 1993 (1993-09-21) * abstract; figure 1 *	3	
A	* abstract; figure 1 *	1,10	
X	EP 0 581 475 A (NORTHERN TELECOM LTD) 2 February 1994 (1994-02-02) * column 2, line 20 - column 3, line 39 * * column 8, line 29 - column 11, line 36 * * column 13, line 19 - line 22; figures 4,4A8,5,5AB,6,6AB,7,7ABC,8,8AB *	1,3,10, 12,16	
INCOMPLETE SEARCH		H01L	
The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC to such an extent that a meaningful search into the state of the art cannot be carried out, or can only be carried out partially, for these claims.		H01L	
Claims searched completely		H01L	
Claims searched incompletely		H01L	
Claims not searched		H01L	
Reason for the limitation of the search: see sheet C		H01L	
Place of search	Date of completion of the search	Examiner	
THE HAGUE	18 April 2000	Mickel, K	
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

DOCUMENTS CONSIDERED TO BE RELEVANT		Category	
Citation of document with indication, where appropriate, of relevant passages		A	
US 5 539 231 A (ISHIKAWA EIICHI ET AL) 23 July 1996 (1996-07-23) * column 5, line 16 - column 7, line 8; figures 1-13 * -----		1-3,5	
Relevant to claim			
CLASSIFICATION OF THE APPLICATION (IntCl.7)		TECHNICAL FIELDS SEARCHED (IntCl.7)	

EP 1 020 905 A1

PARTIAL EUROPEAN SEARCH REPORT

Application Number EP 00 30 0072

European Patent Office



INCOMPLETE SEARCH  
SHEET CApplication Number  
EP 00 30 0072European Patent  
OfficeClaim(s) searched completely:  
2,3,14,16Claim(s) searched incompletely:  
1,4,5,6,7,10,12Claim(s) not searched:  
8,9,11,13,15

Reason for the limitation of the search:

Claims not searched:  
Claims 8,9,11,13,15 lack conciseness due to the large number of occurrence of the words "and/or" linking different features of the claim. Combination of the "and/or" options occurring in each of these claims would further lead to a lack of support by the description.  
Claim 9 is furthermore unclear since it specifies the composition of a barrier metal layer that is not mentioned in claims 1 or 2, on which claim 9 is dependent.

Claims searched incompletely:  
Claim 1 does not specify the arrangement of the first and the second opening as to each other, and further misses process features as to the way of selective deposition of the first conductive layer (e.g. no mask is mentioned). This claim, and all claims dependent on claim 1, were searched according to fig. 3 for the arrangement of the two openings, and according to fig. 5 and p.11, line 28 of the description for the way of selective deposition.  
Claim 5 and 7 miss process features as to the way of etching the specified dimensions of the two openings, and were searched according to fig. 4.

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ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.

EP 00 30 0072

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on

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18-04-2000

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			07-07-1998
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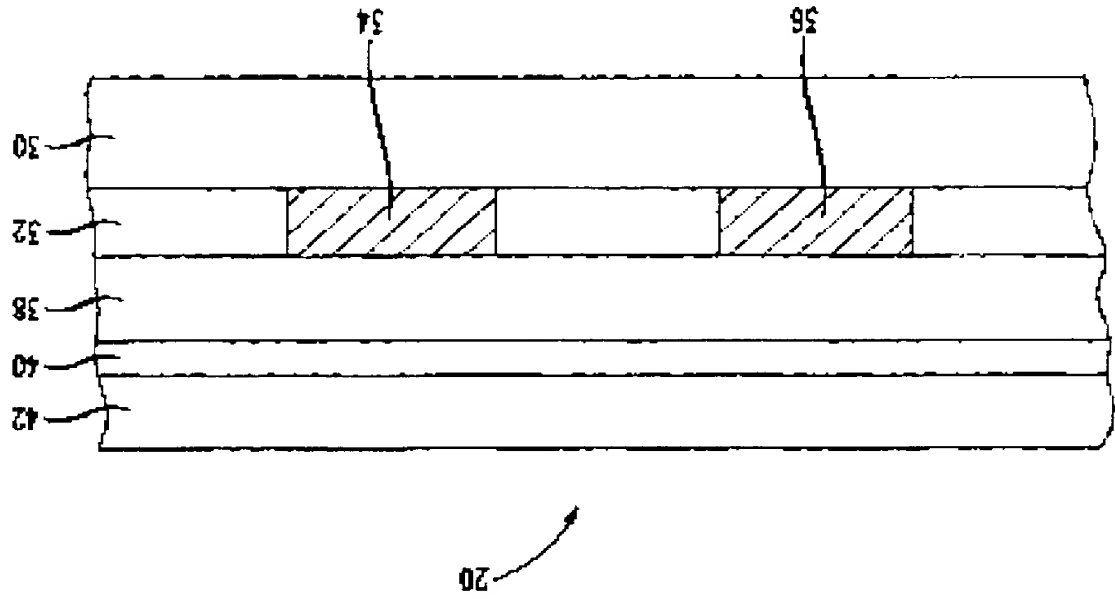


FIG. 2

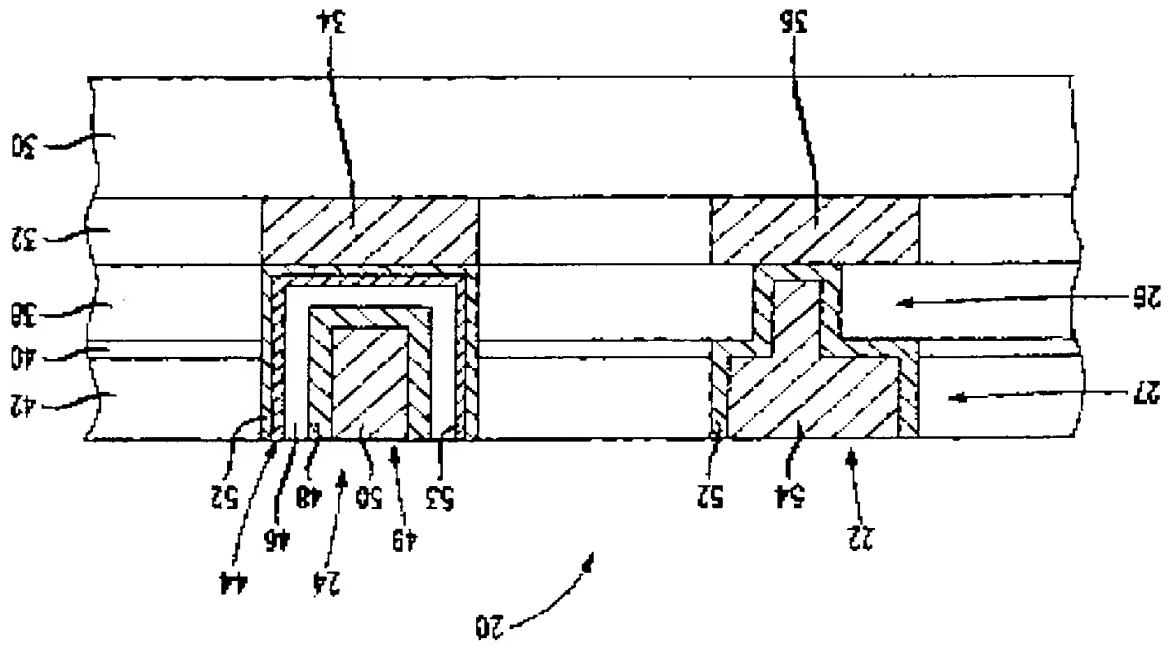


FIG. 1

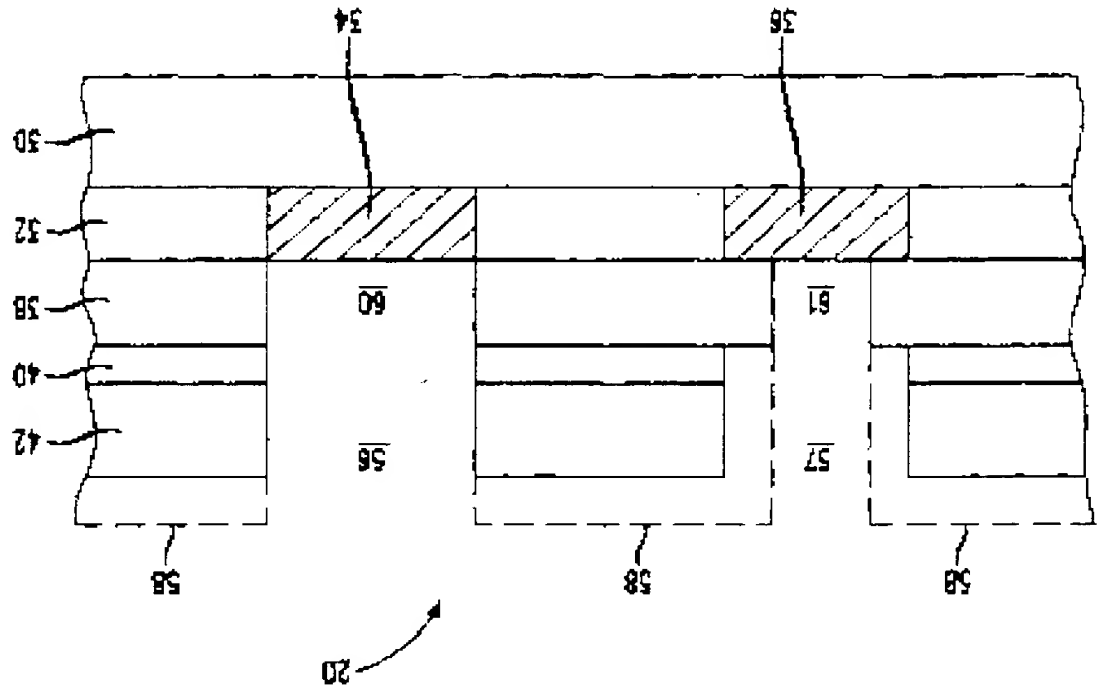


FIG. 4

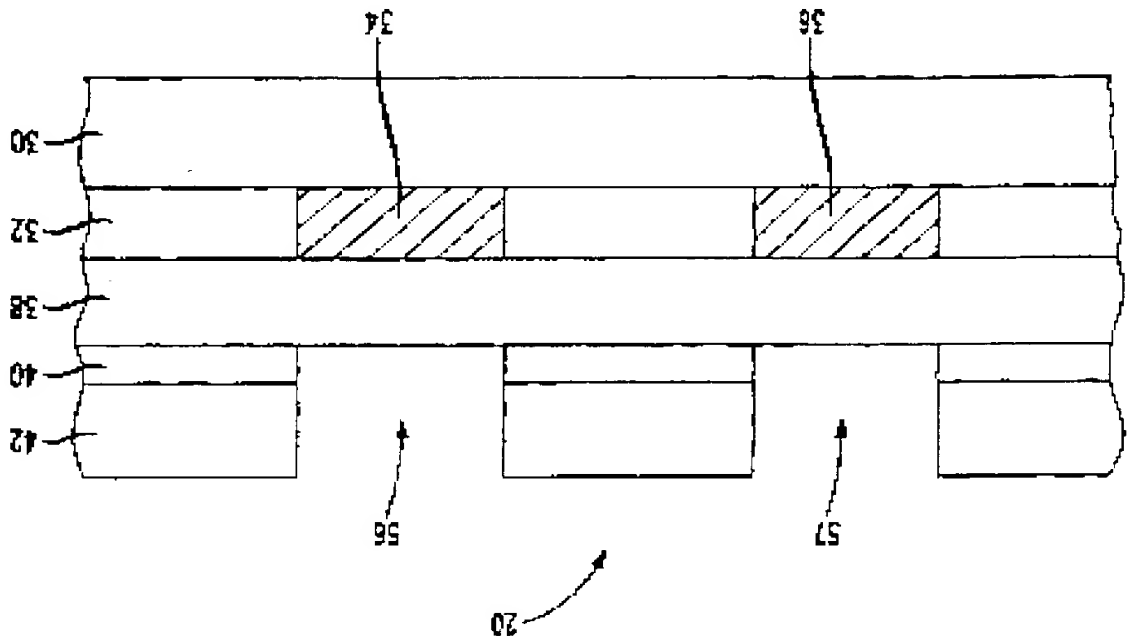


FIG. 3

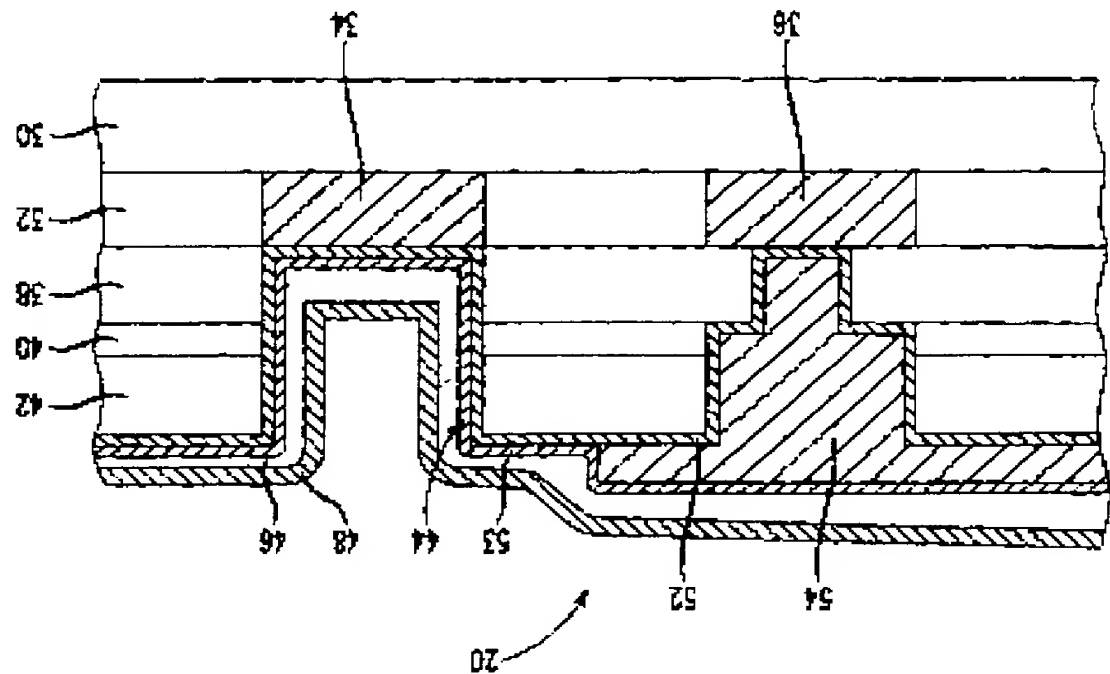
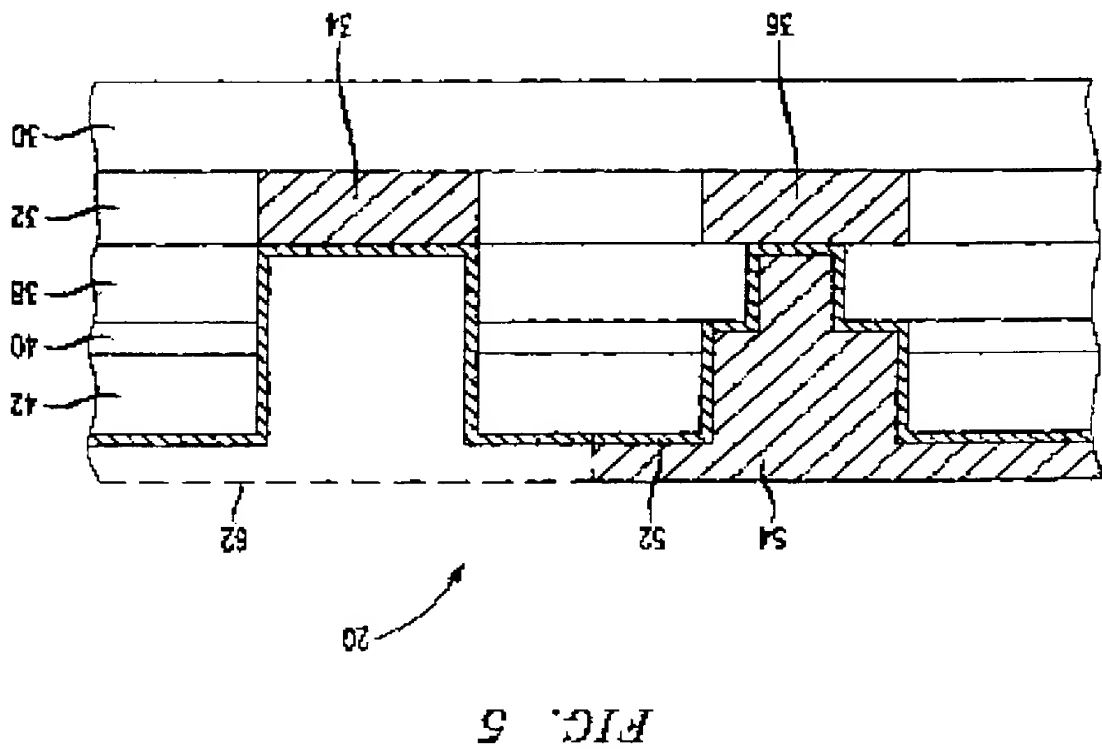


FIG. 7

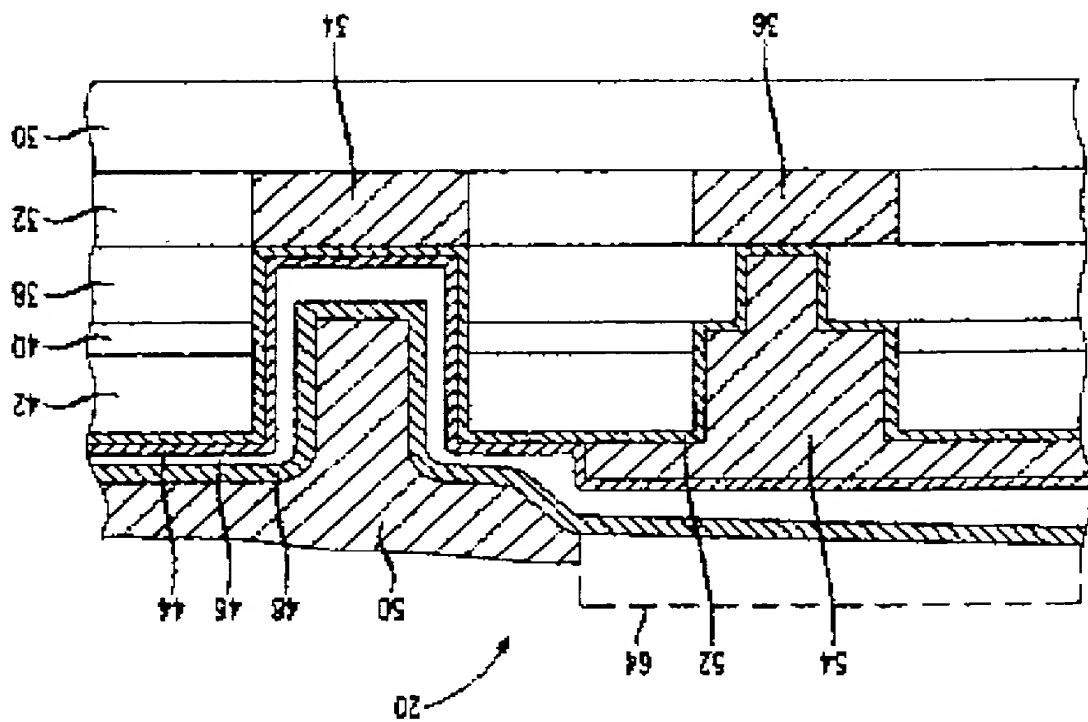
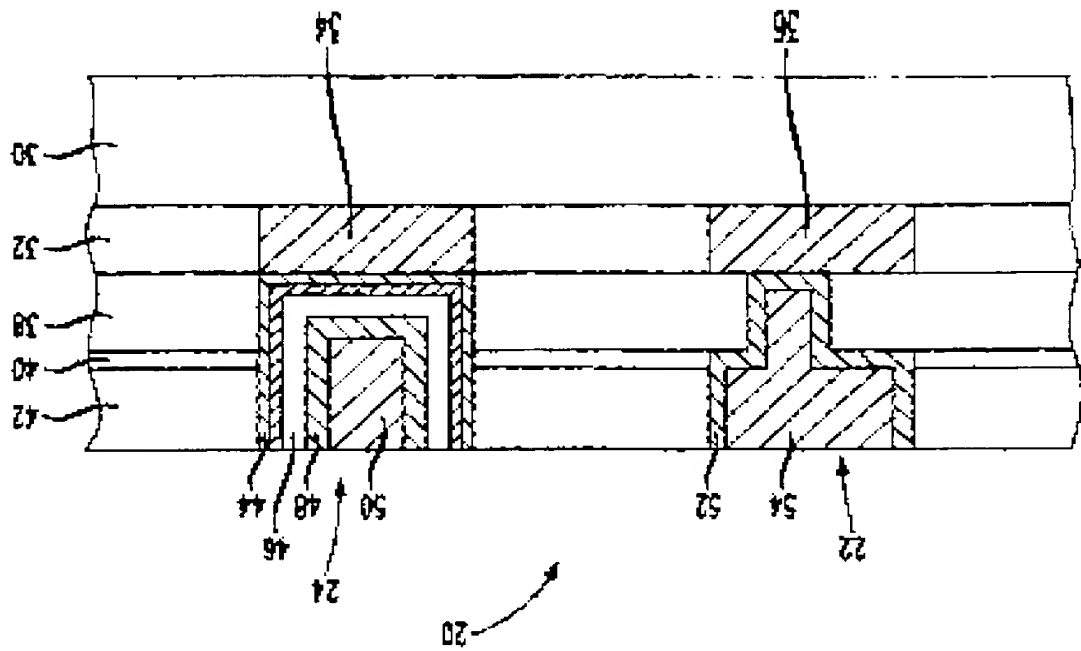


FIG. 8



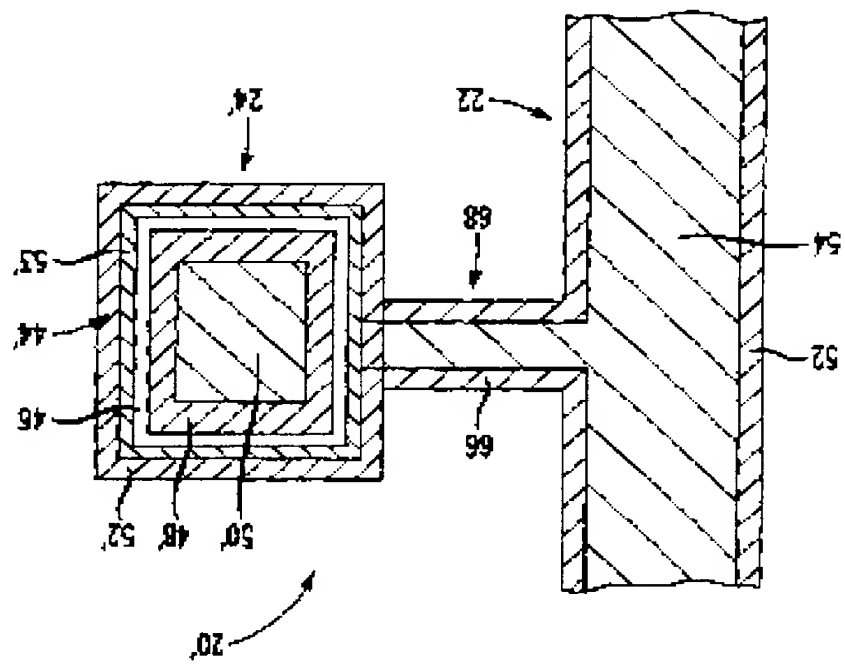


FIG. 9

